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Ceylon

NATURAL RESOURCES IN CEYLON

By J. C. CHANMUGAM,
Deputy Surveyor General,
B. Sc (Lond), F. R. I. C. S.

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NATURAL RESOURCES SURVEYS IN CEYLON

BY

J.C. Channugan, Deputy Surveyor General, B.Sc(Land), F.R.I.C.E.

1. NEED FOR RESOURCES SURVEYS. It is essential to diversify the economy of Ceylon. Exports of tea, rubber and coconut earn nearly 40% of the national income. More than half the imports is on items of food, and only a third of the staple food of the people, rice, was produced locally, until World Wars I and II stressed the necessity for stepping up food production. Rice production was increased to 45% chiefly by opening up more paddy lands under major and minor irrigation schemes. The policy of development was to increase the capacity of the existing schemes and restore abandoned reservoirs. Later some new irrigation schemes, notably the Gal Oya project, were commenced; but it was found that the water available in the Dry Zone was inadequate and had to be obtained from the Wet Zone watersheds. Without any survey of land use potential the original plans and phases of development had to be revised from time to time, resulting in unsuitable cropping and wasteful effort.

The pressure of population, which has more than doubled in fifty years, and the stagnant economy, made it imperative that a rapid evaluation of the existing and potential resources be carried out for planning agricultural expansion and hydro-power development.

2. AERIAL SURVEY METHODS AND THE CANADIAN PROJECT. The Mission organized by the International Bank for Reconstruction and Development recommended a comprehensive evaluation of land use potential, based on an aerial survey of the Island. A series of maps was to be prepared therefrom, showing such features as: the distribution of natural vegetation, arable and pastoral land; the major soil types; major features of topography; irrigation areas- actual and potential; structure and tectonic patterns and other significant matters such as density of population and transport facilities.

2.(a). Colombo Plan Aid was sought for the survey, as neither expertise nor equipment was available in Ceylon. Dr. J.D. Mellard, at the request of the Canadian Colombo Plan Administration, recommended a practical, on-the-job training of Ceylonese personnel, combined with the actual mapping of natural resources and the establishment of a Resources Survey Centre, where studies could be initiated, organized and pursued. The project was financed by the Government of Canada and executed by the Photographic Survey Corporation Ltd., (now Hunting Survey Corporation) of Toronto, under contract.

The studies carried out and the methods are summarised:-

2.(b)(1). AIR PHOTOGRAPHY. Vertical air photography was taken from a Lockheed Hudson Aircraft equipped with a Wild RC 5 Camera fitted with a 6-inch lens. The entire island was covered on the photoscale of

Semi-controlled mosaics (scale 1:31,680) were prepared for plotting data obtained from stereoscopic examination or ground observations. A laboratory was established in Colombo and Ceylonese personnel trained in aerial camera operation, laboratory techniques and preparation of mosaics.

Ceylonese pilots were trained to operate a Beechcraft Super 18 presented by the United States of America. The aircraft is fully equipped for aerial photography.

2.(b).(ii). TOPOGRAPHIC MAPPING. Topographical maps (scale 1:63,360 with 100-foot contours) compiled from plane table survey done several decades ago, were found to be inadequate even for reconnaissance planning, although they had been revised systematically. It was decided to augment them by a National Map Series on the scale of 1:12,672 with contours at 20-foot vertical interval. Kelsh plotters installed in the Air Survey Branch were used in this mapping; but an extent of 2100 square miles was given out on contract, as that was urgently required for projects under way. Although simplicity of design and low cost of the Kelsh Plotters are advantages, difficulty in interpreting fine detail and fatigue in plotting from an anaglyph model have led to the use of second order mechanical projection instruments for mapping areas where much detail (planimetric features) is present.

Photography on the 1:40,000 scale is used and the plotting is done in colour pencil on plate boards at publication scale (except where engineers require working plans on larger scales).

Full ground control is provided for every model supplemented where the forest canopy is dense, by ground heights along lines 2 miles apart, in an attempt to overcome the difficulty of estimating free heights.

The boards are directly used for field checking and insertion of missing detail. Between 5% - 10% of the detail and contours are checked by plan tabling. This proportion will be reduced as the stereographers gather more experience. The field checks reveal that the standard specifications for horizontal and vertical accuracy for this class of work have been maintained.

For reproduction, colour separations are prepared direct from the boards by positive scribing on coated plastics using diamond cutters.

The output in 1961, was 126 acres per hour per mechanical projection instrument, and 97 acres per hour per anaglyph projection instrument. Better out-turn is expected with more experience.

2.(b).(iii). LAND AND WATER RESOURCES SURVEYS. These surveys provide an inventory of the land and water resources in a river basin, to evaluate their potentialities for development, to prepare a tentative plan for their future use and to enumerate the additional surveys and studies that would be required, before specific development projects are undertaken. The survey and mapping of land-forms, geology, soils, land use and forest cover, were carried out by a combination of photo-interpretation and ground survey. Field traverses were of sufficient density to establish the main pattern and confirm the mapping done on air photographs. Hydrological data were collected from the Departments of Irrigation and Meteorology, and statistical analysis made on I.B.M. electronic computers in Toronto. The results of the field and statistical studies were examined in conjunction with the results of the mapping described earlier and preliminary plans for irrigation and hydel power development formulated.

2.(b).(iv) FORESTRY. Photo-interpretation for evaluation of tropical forest wealth is handicapped by the complexity of patterns, but a pilot project carried out in the Sinharaja Forest Reserve, a tropical rain forest with a heterogeneous composition, demonstrated that field work can be greatly reduced, maps made more reliable, and stock enumerated with a reliable degree of accuracy. The procedure and methods had to be worked out as the survey progressed.

The field work was carried out in two stages. The cost of the first stage was Rs. 229/- per acre enumerated. The cost per acre of the second stage was Rs. 105/-, the reduction being due to better organisation using the experience gained from the first stage.

Photo typing in the area was done on the 1:15,840 scale photographs. A forest stratification system was evolved whereby Wet Zone forests could be classified into five yield groups, and Intermediate and Dry Zone forests into three yield groups each, conforming to the "Woodland" category of land-use classification adopted by the Commission on "World Land-use Survey".

Forest-type and drainage maps were prepared using a Watts Radial Line Plotter, on the scale of 1:15,840, and extraction plans on the scale of 1:31,680 on photographic enlargements of the 1-inch map.

This project proved that, mapping at reconnaissance level, broad yield groups can be interpreted with consistency on the available 1:40,000 scale photographs. Fifteen forest reserves or proposed reserves were inventorised in this manner. The photo typing was done on 1:40,000 scale contact prints and detail transferred visually to the semi-controlled 1:31,680 scale mosaics. The location of sample plots was determined by accessibility and dispersion of each stratum. Sample lines were plotted on the mosaics and typing checked. The intensity of sampling varied according to merchantability and was controlled by the standard error of the basal area to ensure accuracy within acceptable limits.

The maps showing the forest types and other details, including the location of the sample plots, were published on the scale of 1:50,000.

2.(b).(v) GEOLOGY. A tectonic map was prepared on the scale of 1:253,360 by interpretation on 1:40,000 scale photographs transferred to the mosaics on the scale of 1:31,680 and reduced photographically.

This map is useful not only for selecting zones for exploration of unmapped areas but also for revising the existing geological maps. It was possible to locate some minerals, especially Ceylon graphites, the more important deposits being known to be epigenetic and intrusive in origin.

Gems in Ceylon are generally found in beds of certain rivers, which have presumably at some stage of their geological history eroded the gem bearing formation, and fossil river beds have been mapped from the photographs for future exploitation.

Underground water was tapped by drilling where an alluvial belt is crossed by a regional fault, or at the contacts between quartzite or crystalline limestone with country rock.

2.(b).(vi) GEOPHYSICAL SURVEYS. Airborne geophysical surveys were carried out using a Canso aircraft equipped with Gulf Airborne Magnetometer Mark III and Airborne Scintillometer Model 1950 R made by Measurement Engineering Ltd., a Radar Altimeter APN I and 35 m.m. camera for taking vertical photographs to locate the flight lines. The results of the

aeromagnetic surveys were shown as contour maps showing lines of equal total magnetic intensity, on various large scales. They were combined into composite maps on the scale of four miles to an inch. Although no large deposit of magnetic iron ore was indicated, the maps were useful to the geologist to identify large magnetically consistent areas as one rock type, with a few scattered observations instead of slow and arduous traversing.

The airborne radiometric surveys were mapped in the form of contours showing lines of equal radioactive count. A coastal strip where monazite beach-sand deposits were known to exist, was the only area actually contoured as it had been found in Canada and elsewhere that a good number of radiometric anomalies were produced by large areas of low radioactive materials, especially where igneous rocks having a fair topographic relief were prevalent.

Detailed radiometric surveys were however carried out in selected areas, flying at 300 to 500 feet with flight lines 1/8 and 1/4 mile apart. A total of 230 significant anomalies were detected, and will form the subject of further ground surveys. Except for these anomalies, which are elongated along the coast, indicating readily extractable monazite, the others are presumed to be due to uneconomic deposits of radioactive materials.

The airborne surveys were followed up by ground surveys, using a refractive Seismograph Model M.D. for shallow depth seismic determination, magnetometer surveys to delineate the extent of magnetic iron deposits, and radiometric surveys using Scintillometer E.135 ST and Geiger Counter EA 135.

Ground electromagnetic traverses were carried out to test the Ronka Horizontal Loop ground electromagnetic equipment used in Ceylon for detection of mineral deposits which possess fair conductivity.

3. RESOURCES SURVEY CENTRE. A Resources Survey Centre was established in Colombo under the Canadian Project to co-ordinate the geological, agricultural, forestry, engineering and other studies of the Canadian Team, edit their reports and train Ceylonese personnel. A Project Manager supervised its functions and the work was co-ordinated by the Surveyor General who took over the Centre on completion of the Canadian Project. The functions of the Centre are to collect and evaluate by photo-interpretation, physical resources potentialities and furnish maps and integrated reports on proposed development schemes for critical analysis by technical and economic advisers regarding the feasibility of such projects; advise other Departments on the scope and utility of photo-interpretation for their needs; and train personnel in these fields as needed by other Department.

3.(a). The Centre is supported by a number of other sections of the Air Survey Branch.

3.(a).(i). The PHOTOGRAPHIC SECTION is responsible for flight planning, air photography, reproduction of prints, diapositives, enlargements, reductions and mosaics and processing ground photographs.

3.(a).(ii). The PHOTOGRAMMETRIC SECTION is responsible for ground control lay-out, planimetric and topographic mapping and allied work.

3.(a).(iii). The ADMINISTRATIVE AND LIBRARY SECTION is responsible for finance and supply; handling orders for photographs and mosaics, maintaining up-to-date library of air photographs; cataloguing technical books, journals and reports and coordinating the work of the different sections.

3.(a).(iv) THE MAP REPRODUCTION BRANCH of the Survey Department is responsible for fair drawing, proofing, editing and printing of maps.

3.(b). Three Ceylonese officers recruited to man the Centre worked with the Canadian Team before and after they followed post graduate courses in Photo-engineering, photo-geology and photo-forestry at the International Training Centre for Aerial Surveys at Delft, Holland.

The flow of work to the Centre depends on the requirements of other Departments and the requests are so numerous and diverse that it has been decided to train three more officers.

3.(c). The chief jobs awaiting attention are -

3.(c).(i). National Map Series on the scale of 1:12,672, showing contours at 10 or 20-foot vertical interval. About 4/5ths of the Island or 20,000 square miles remain to be mapped; and extensive mapping is very urgently required. The available 4 machines cannot meet the demands. The makers require about 2 years to deliver the additional machines now on order, and therefore some of the more urgent mapping has to be given out on contract.

3.(c).(ii). The Department of Agrarian Services is in charge of minor irrigation works which have been constructed in ad hoc manner, each improvement not fitting into a single overall plan, for the development of the river basin as an entity. A survey is required to assess the cropping in each season and the reasons why any land lie fallow. The mapping will be carried out by photo interpretation of land use, soils and water resources and analysed by examination of statistical records and questionnaire to growers. Where undercropping is due to physical limitations, proposals to offset the deficiency are required. The extent of the survey could be gauged by the fact that approximately 800,000 acres, or 75% of the total extent of paddy lands, are under minor schemes.

3.(c).(iii). The Forest Department requires forest inventories and management surveys in about 50 more forest reserves for planning management and extraction.

4. AID REQUIRED. The Seminar on Aerial Surveys held in Bangkok in January 1960 adopted a resolution proposed by the author for the establishment of a Centre for Training in Photogrammetry and Photo-Interpretation in the South East Asian region.

The Third United Nations Regional Cartographic Conference for Asia and Far East held in Bangkok in November, 1961 resolved to further examine the problems connected with the establishment of such regional and sub-regional training centres for photo-interpretation and has appointed a working committee to work out the organisation, scope and requirements for such establishments.

As such an organisation would help accelerate the supply of basic material for efficient planning of the economic and social development of less developed areas, it merits the active consideration of the Economic and Social Council. A suitable group may be designated to visit the various organisations in the different countries and formulate a scheme for establishing such Centres to impart and receive the benefit of recent advances in the application of modern methods and to fulfil the aims of this Conference.

4.(a). Ceylon needs expert advice in the following fields :-

4.(a).(i). Land use, soils and surface and underground water resources studies to carry out a pilot project to determine the procedure and working methods for the surveys referred to in para. 3.(c).(ii).

- 4.(a).(ii).Geophysical studies to follow up the air-borne surveys referred to in para.2.(b).(vi).
- 4.(a).(iii).Detailed soil studies to follow up the land use recommendations under the Canadian Project.
- 5.The Canadian Team furnished the following reports relating to their studies in Ceylon :
- 5.(a) Land and Water Resources Surveys.
 1. The Kirindi Oya Basin^c
 2. The Walawe Ganga Basin^a
 3. The Mahaweli Ganga Basin^b
 4. The Kelani Ganga-Aruvi Aru Area^b
- 5.(b).FOREST SURVEYS
 1. Forest Inventory of Ceylon^b
 2. Management Inventory of the Delwala-Walankanda Forest^a
 3. Management Inventory of the Kanneliya-Nakiyadeniya-Dediyagala Forest^a
 4. Management Inventory of the Morapitiya-Runakanda Delgoda Forest^a
 5. Inventory of the Madhu Forest^a
 6. Inventory of the Kumbukkan Forest^a
 7. Inventory of the Nuwaragala and Omunugala Reserves and the Ratkarawa Proposed Reserve^a
 8. Inventory of the Palkelele Forest Reserve^a
 9. Inventory of the Peak Wilderness-Agra Bopats Forest Area and Kelani Valley Forest Area (Part)^a
 10. Inventory of the Bambarabotuwa-Massena-Morahela Forest Area and Kelani Valley Forest Area (Part)^a
 11. Inventory of the Kantalai Reserve^a
 12. Inventory of the Terravil-Oddusuddan Reserve^a
 13. Inventory of the Indikada,Kirigala and Kurana-Madakada Proposed Reserves^a
 14. Inventory of the Attavillu Reserve^a
 15. Inventory of the Hurulu Reserve^a
 16. Enumeration Survey of the Navakiri Ara Teak Plantations^c
- 5.(c).GROUND GEOPHYSICAL SURVEYS.
 1. Use of the Refraction Seismograph Model MD-1^c
 2. Makandura Magnetometer Survey for Magnetic Iron Ore^c
 3. Use of the Ronka Horizontal Loop Electromagnetic Equipment in Ceylon^c
 4. Maddegama Radiometric Survey for the Radiometric Mineral Thorianite^c
 5. Induruwa and Kosgoda Radiometric Surveys over Monazite Beachsand^c
 6. Mitipola Radiometric Survey for the Radiometric Mineral Thorianite^c
 7. Summarizing Report of the Geophysical Operations in Ceylon^c

a: Published; b: Under publication; c: available for reference in Ceylon.